PATENT SPECIFICATION

1,042,179

1,042,179

Date of Application and filing Complete Specification: September 20, 1963. *No. 37102/63*

Application made in France (No. 910073) on September 21, 1962.

Complete Specification Published: September 14, 1966.

Index at Acceptance:—**H4** F (2EX5, 5A); **G6** C2K; **H4** T1.

Int. Cl.:—H 04 n 5/26 // G01r, G21.

COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in Television Cameras

We, COMPAGNIE FRANCAISE THOMSON-HOUSTON, a French Body Corporate of 173 Boulevard Haussmann, Paris 8ème, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in television cameras, and more particularly to those which may be used in surroundings at a high temperature.

Industrial television cameras permit the observation of phenomena in different media where direct observation of the phenomena is difficult. Examples are submarine television, medical television, etc.

In some cases, the televising takes place in surroundings at a high temperature; for example when making observations of the interior of furnaces.

The use of television cameras in a high temperature medium raises problems in relation to the electronic components and internal connections utilised. Although various of the electronic components, such as resistors, capacitors, or tubes, may be used over a wide temperature range, this is not true of the camera tube, which cannot easily be subjected to a temperature greater than 60°C. This being so, it is therefore necessary to provide an appropriate cooling arrangement to keep the whole of the camera apparatus and in particular the analyser tube at a permissible temperature. In the case of fixed installations, this arrangement may consist of a system of pipes for circulating a coolant fluid around the camera. It is also possible to use cooling plates making use of the Peltier effect. However in both these cases the cooling installation is cumbersome, heavy and fairly expensive.

The heat given off internally by the electronic components assists in heating the camera when it is in a medium which is already at a high temperature, so that it is necessary to provide a cooling arrangement, as mentioned above, in addition to heat insulation. Where the camera is cooled by the circulation of a fluid, such as water, for example, there is always a danger of leakage, which has to be avoided where the camera is to be used in a medium which would be modified by the fluid.

The problem of providing a camera with a suitable cooling arrangement becomes particularly complicated when it is a mobile camera without a circulating cooling system.

The scene is usually televised along the optical axis of the camera. When it is to be televised laterally, say at right angles, it is necessary to use a special optical device.

The object of the present invention is to provide a television camera enabling the aforementioned difficulties to be reduced or overcome, which is largely self-contained and which is suitable for use in surroundings at a high temperature.

Accordingly the present invention consists in a television camera assembly comprising a double-walled jacket forming a reservoir for a coolant fluid, the jacket embracing a sealed enclosure in which is located the operational apparatus of the camera, expansion of the coolant fluid in the jacket producing a cooling of the walls of the latter and of the said enclosure, this cooling permitting, during the period of existence of the fluid in said reservoir, maintenance of the camera apparatus at a controlled operating temperature in a high temperature environmental medium, the said coolant jacket and camera apparatus in the enclosure being removable and replaceable with respect to, and independently of, each other.

When the camera is used in a gaseous

atmosphere exposed to nuclear radiation, it is essential that the coolant fluid used does not modify the characteristics of the surrounding atmosphere should it vaporise out of the camera.

According to a feature of the invention, therefore, when the camera is used in a gaseous environment exposed to nuclear radiation, the coolant fluid used has where possible, the same nature as the gas surrounding the camera, with an escape valve, being provided for directly evacuating the gas produced by the expansion into the gaseous environment which has the same chemical composition.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a section through the whole of one embodiment of camera apparatus constructed in accordance with the present invention; and

Figure 2 shows a partial section through an alternative embodiment of the camera according to the present invention.

The camera assembly shown in Figure 1 may be divided up into two parts: namely the operational part of the television camera and a part comprising the cooling arrangement, in the form of a cylinder containing the coolant fluid, surrounding the operational part.

The operational part is contained in a metal tube 22, having dimensions determined by the diameter of the camera tube 1, by the volume required by the coolant fluid contained in the cooling arrangement and by the maximum outer dimensions of the camera assembly. This tube 22, is sealed and contains the camera tube 1, which may, for example, be of the 'Vidicon' type, and behind which is arranged an electronic amplifier 2, connected by a connection assembly 3, to a sealed connector 4. The front part also comprises a lens 8. The optical members are completed by a lighting system 10 and a fixed reflecting conical surface 14, both of which may be disassembled.

Although the following and other details do not form an essential part of the invention claimed, they are given by way of additional explanation of the uses to which a camera incorporating features according to the present invention may be put.

In practice, the subect of observation is usually an obect such as a wall part of a sheath of a fuel element located at right angles to the optical axis of the camera lens 8. The object is thus observed through a conical mirror 8.

The object AB illustrated is an annular sheath portion 19, with a generatrix depending on the distance of the wall surface to be examined and the focal length of the lens used. For a given distance of the wall, it is of course possible to obtain an image with a longer generatrix by using a lens with a shorter local length. An example of a suitable lens is one with a focal length of 35 mm. Of course the image A'B' is anamorphised owing to the effect of the conical mirror but this is of no importance. In practice, even, any longitudinal cracks observed will be enlarged in width.

The lens assembly 8 is protected by a cut transparent quartz disc 9 sealing the tube 22.

The image AB arrives at the conical mirror 6 after passing through an optical cut glass ring 20 welded to two metal mounting rings. Small low-voltage lamps 10 are arranged in front of the mirror 6 and light up the wall surfaces of the sheath 19. Since the optical part (numbered generally 14 and including mirror 6, lamps 10, and glass ring 20) is fragile, it is protected from impact in operation by an appropriate device such as a circular dish 18 provided on the cooling arrangement 13 and fixed, for instance, by metal rods.

The cooling arrangement, i.e. the other part of the assembly, is constituted by a double-walled heat-insulating vessel 13 of polished stainless steel, argon welded, the air being evacuated from the annular parts 12 between its walls. This vessel which is for example, of 4 litres total capacity, contains liquid carbonic anhydride (C02) which is introduced into the interior 11 of the vessel by a filler valve 16. The liquid C02 expands through metal valves 15, fixed at the rear of the vessel near the connector 4 of the connecting cable 5, directly into the sheath under observation. The valves 15 comprise a suitable mechanism whereby fluid exhaust from the vessel 13 is automatically controlled depending on the external pressure of the medium around the said vessel. The expansion of liquid C02 causes a powerful cooling of the walls of the vessel. This cooling effect acts in turn on the operational part of the camera inside the vessel and keeps the temperature of the camera at a permissible operational level.

The metal tube 22 enclosing the operational part is inserted as a single assembly into the heat-insulating vessel, which has been filled with the coolant fluid, and a circular nut 17 locks it from behind. As these two parts are very quickly disconnected or assembled, a number of coolant vessels may conveniently be filled before use of the assembly so as to allow for observation over a longer period with only the short interruptions necessary to replace a 'spent' vessel.

The camera assembly is held in the axis of the sheath by guide springs 7 of stainless steel or by any other suitable arrangement, such as rollers, for example, allowing for accurate focussing over the entire length of the sheath.

The camera described above, although shown in Figure 1 in a horizontal sheath, is particularly intended for use in vertically disposed nuclear reactors sheaths in which the carbon dioxide gas circulates from the bottom to the top at a considerable rate, viz. from several meters to several dozen meters per second, and at very high pressure. It descends inside the sheath under its own weight; and is connected by its supply and suspension cable 5 to a suitable arrangement controlling its descent or ascent. If the temeprature of the CO_2 gas is high (from 200°C to 400°C) and if the nuclear radiation of neutrons or of gamma rays is considerable, appropriate arrangements are made for the material used in the camera to be subjected to this temperature and the various radiations without sustaining damage. Hence, special resistors resiting the various radiations, tetrafluoroethylene resin - (such as 'Teflon' or 'Fluon') - armoured cables, (Trade Marks) and wires with special insulation, such as wires insulated with siliconised fibreglass, etc. are used in the camera.

The foregoing description relates more particularly to a camera which is simple to operate and intended for a specialised use.

Figure 2 shows alternative embodiment of the camera, in which certain improvements and modifications have been made, making it possible to use it at a higher temperature and for a number of purposes. This camera is, however, based on the camera described above: only its front end differs and this will be described in detail.

In order to improve the quality of the image obtained, a vidicon scanner tube 1 of larger dimensions than the tube used in the aforementioned embodiment is used. This tube makes it possible to achieve greater definition of the image (700 to 800 points).

Since it is chiefly the front end of the vidicon scanner tube which needs cooling, the cooling arrangement described above has been modified, its rear end having a similar arrangement for supplying and exhausting the coolant to that previously described. The heat-insulating vessel has an evacuated space 12, a compartment 11 for the liquid CO_2 and an annular space 30 in which the liquid CO_2, which arrives through a pipe 5 in the form of an inner tube 31, communicating with 11, is evaporated and expands. This expansion inside the annular space 30 has an intense cooling eeffct. The gases then escape through a further pipe 5′ in the form of an inner tube 32 communicating with the outside environment through a valve located close to the sealed electrical connector described above in relation to Figure 1. Since the annular space 30 surrounds the front end of the tube 1 it is more energetically cooled.

In order to make the camera suitable for use as a multi-purpose camera, the lens 8 has been made dismountable through the front end of the tube containing the operational part of the camera. For this purpose, a dismounting nut forming a locking ring 27 is unscrewed, thus making it possible to remove the transparent sealing glass 9 and the lens-holder, which makes it possible to use lenses of different focal lengths. A focussing device is also provided. To this end, the lens carries a continuous sinusoidal groove 33 in which a fixed finger 34 is engaged. A gear 35 linked to the lens holder makes it possible to rotate the said lens-holder, and so, by virtue of the groove 33 and the fixed finger 34, to move the lens along its optical axis. A pinion 29 fixed to a shaft which passes through the camera is controlled by a small step-by-step motor with a pawl and a control electromagnet (not shown in the drawing). The pinion 29 engages the gear 35 and by rotating the motor by pulses, the focussing position of the lens is adjusted. After this has been set pulses are no longer sent. This method of tele-controlled adjustment makes is possible to prevent electrical interference during examination.

The field of vision is illuminated by low-voltage lamps 10 arranged on the front end of the heat-insulating cylinder around the central optical opening.

The camera just described may be used for observation along the optical axis of the camera.

In order to allow for lateral examination, the front part of the camera is completed by a dismountable part 14 mounted on the heat-insulating vessel by screws 28. It comprises a revolving turret support 26 for a mirror 6 inclined at 45° and protected by a transparent glass face 20.26. This turret is fixed to a gear 36 driven by the rotation of a gas turbine motor 23 and capable of being stopped in a desired position by an electromagnetic brake 25. The whole of the dismountable part 14 is protected in front by a cap 24 with an opening 37 through which carbon dioxide gas, being for instance, in forced circulation in a reactor sheath, may pass into the turbine motor 23.

There are two reasons for rejecting an electric motor as means for rotating the mirror. On the one hand, the temperature of the operational environment and on the other hand, interference caused by an electric motor, which would be likely to blur the image obtained by the camera tube.

Where the camera is specially intended for use in a nuclear reactor sheath through which a violent stream of CO_2 gas under pressure circulates at a high speed, the aforementioned gas turbine motor 23 is used. This prevents the intrusion of any troublesome interference upsetting the observation of the image produced. The interference produced by the tele-controlled electric brake

25 is not very troublesome and disappears as soon as this brake has stopped the rotating mirror and consequently it is held stationary so that detailed observation can be made.

The claimed features of the television camera described above make it also suitable for other purposes and of course for less rigorous operational conditions. Its shape makes it particularly well adapted for exploring pipes and the like.

Whilst particular embodiments have been described, it will be understood that various modifications may be made without departing from the scope of this invention.

WHAT WE CLAIM IS :—

1. A television camera assembly comprising a double-walled jacket forming a reservoir for a coolant fluid, the jacket embracing a sealed enclosure in which is located the operational apparatus of the camera, expansion of the coolant fluid in the jacket producing a cooling of the walls of the latter and of the said enclosure, this cooling permitting, during the period of existance of the fluid in said reservoir maintenance of the camera apparatus at a controlled operating temperature in a high temperature environmental medium, the said coolant jacket and camera apparatus in the enclosure being removable and replaceable with respect to, and independently of each other.

2. An assembly as claimed in claim 1, wherein the coolant fluid used is of the same nature as a gaseous environment in which the assembly is located or to be located.

3. An assembly as claimed in claim 1 or claim 2 wherein a differential escape valve is provided for the coolant system to evacuate the gas produced by the expansion.

4. An assembly as claimed in claim 1, 2 or 3, wherein the coolant fluid is liquid carbonic anhydride.

5. An assembly as claimed in any previous claim wherein the jacket is a double-walled metal enclosure.

6. An assembly as claimed in any previous claim wherein a space existing between the double walls of the jacket is evacuated.

7. An assembly as claimed in any previous claim wherein the sealed enclosure is provided with an annular chamber through which the coolant fluid may pass to enhance cooling of the enclosure in the vicinity of the said chamber.

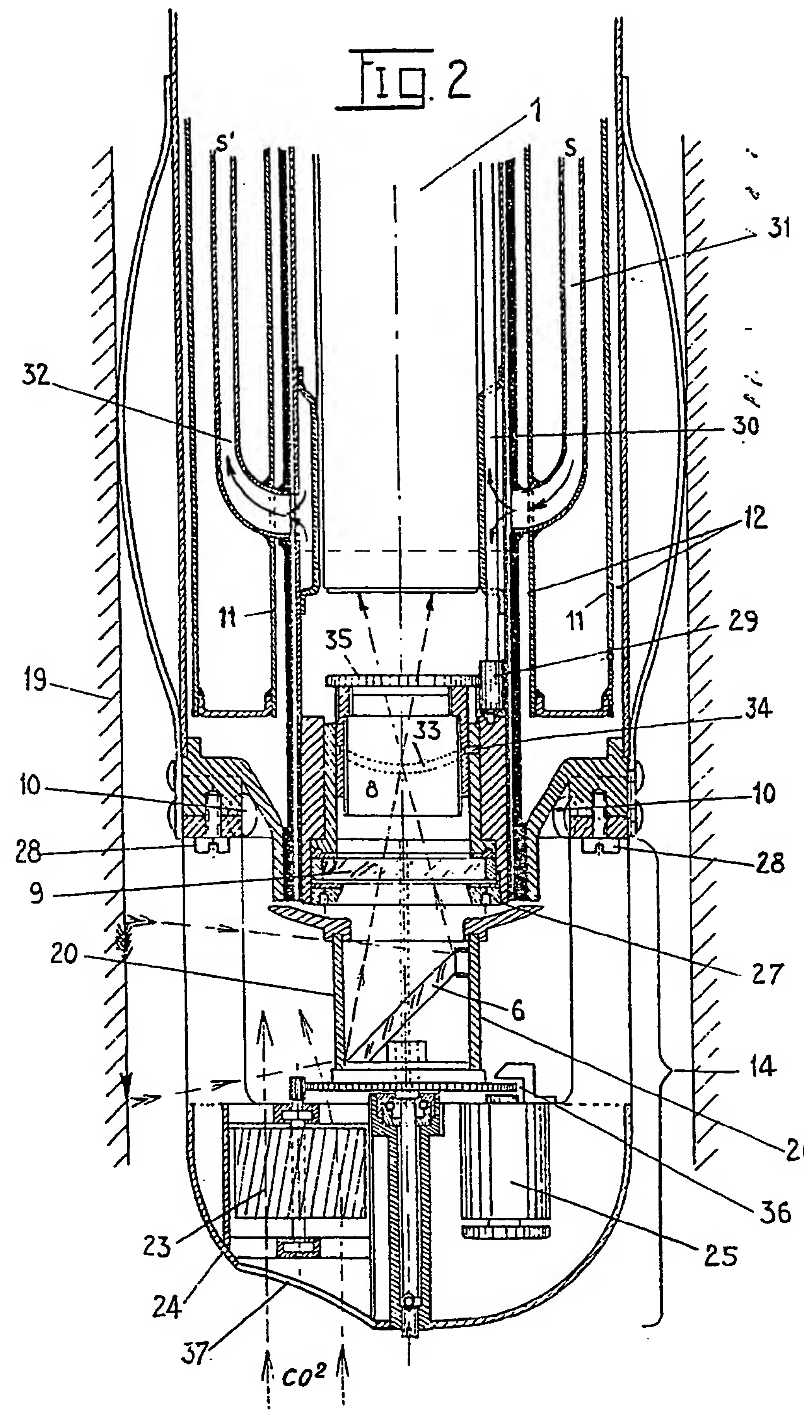
8. A television assembly substantially as herein before described with reference to Figure 1 of the accompanying drawings.

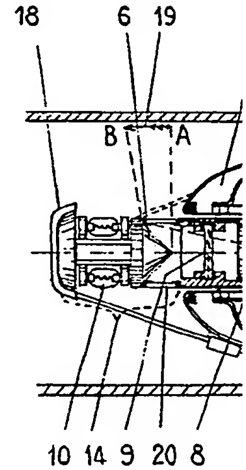
9. A television assembly substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

BARREN & WARREN,
16, Kensington Square,
London, W.8.
Chartered Patent Agents

Berwick-upon-Tweed: Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd.—1966
Published at the Patent Office, 25 Southampton Buildings, London, W.C.2 from which copies may be obtained

Fig. 2


1
S'
S
31
32
30
12
11
11
35
29
19
34
33
8
10
10
28
28
9
20
27
6
14
26
36
23
25
24
37
CO2

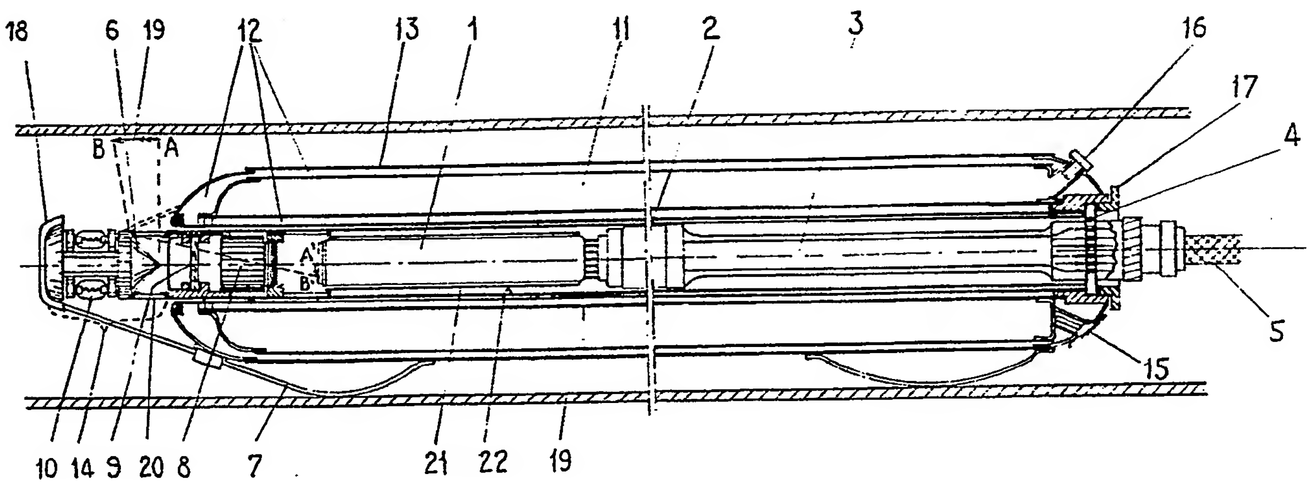

18
6
19
B
A
10
14
9
20
8

1,042,179 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig.1



1,042,179 1 SHEET

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

Fig. 2

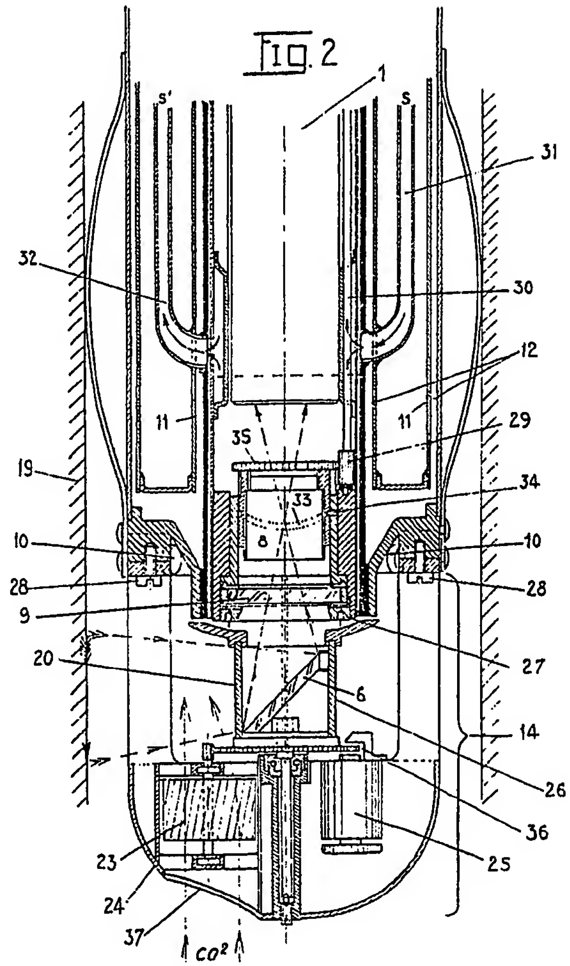


Fig. 1